

CLAIMS

1. A device for forming expansion regions in a tunnel having a given lateral dimension in a bone, comprising:
 - 5 an elongate body having an axis and adapted to fit through the tunnel;
a head, provided on said body and having outer dimensions not extending trans-axially to said body by an amount that would cause it to substantially impact the tunnel diameter in a first configuration and having an outer dimension that does impact the tunnel diameter in a second configuration;
 - 10 wherein said head is rotatable and wherein said head is adapted to widen said tunnel in said bone by at least 5% in conjunction with said rotating.
2. A device according to claim 1, wherein said head is mounted at a distal end of said body.
- 15 3. A device according to claim 1, wherein said head is adapted to rotate eccentrically relative to said axis, when said body is rotated.
4. A device according to claim 3, comprising a sleeve in which said body is mounted.
- 20 5. A device according to claim 4, wherein said head is mounted eccentrically relative to an axis of said sleeve.
6. A device according to claim 4, wherein said head is mounted non-eccentrically relative to an axis of said sleeve.
- 25 7. A device according to claim 4, wherein said head is rotationally locked to said sleeve.
8. A device according to claim 4, wherein said head has a rotationally limited motion relative to said sleeve, between 10 and 350 degrees of rotation.
- 30 9. A device according to claim 4, comprising an interlock which selectively rotationally locks said body to said sleeve.

10. A device according to claim 9, wherein said interlock includes a plurality of selectable interlocking settings.
- 5 11. A device according to claim 9, wherein said interlock is directionally selective in at least two positions thereof preventing relative rotational motion one only in one rotation direction and one only in an opposite rotation direction.
12. A device according to claim 4, wherein said sleeve has a lumen sized to receive said
10 body and wherein said lumen is off-axis of an axis of said sleeve.
13. A device according to claim 1, wherein said head is adapted to rotate centrically relative to said axis, when said body is rotated.
- 15 14. A device according to claim 13, comprising a sleeve, wherein said body is mounted in said sleeve.
15. A device according to claim 14, wherein said head is mounted eccentrically relative to an axis of said sleeve.
- 20 16. A device according to claim 13, wherein said head is radially enlargeable.
17. A device according to claim 16, wherein said head is inflatable.
- 25 18. A device according to claim 1, wherein said head is adapted to crush cancellous bone in said tunnel to cause said widening.
19. A device according to claim 1, wherein said head is adapted to ream cancellous bone in said tunnel to cause said widening.
- 30 20. A device according to claim 1, wherein said head is adapted to remove cancellous bone in said tunnel to cause said widening.

21. A device according to claim 1, wherein said head is adapted to widen said tunnel without moving axially.
22. A device according to claim 1, wherein said device includes a drilling section adapted to form said tunnel.
23. A device according to claim 22, wherein said head includes said drilling section.
24. A device according to claim 22, wherein said head is adapted to selectively drill or widen depending on a rotation direction of said head.
25. A device according to claim 22, wherein said head is adapted to selectively drill or widen depending on an eccentricity of rotation of said head.
26. A device according to claim 22, wherein said head is adapted to selectively drill or widen depending on a radial enlargement of said head.
27. A device according to claim 22, wherein said head comprises at least one forward pointing drill edge.
28. A device according to claim 22, wherein said head comprises at least one axially elongated edge adapted to cut bone for drilling.
29. A device according to claim 1, comprising a plurality of depth indicating axial markings.
30. A device according to claim 1, comprising an axially positionable depth limiter.
31. A device according to claim 1, wherein said head and said body are cannulated.
32. A head adapted for drilling a tunnel and for widening an existing tunnel, comprising:
(a) at least one drill cutting edge arranged for cutting bone in a forward pointing direction; and

(b) at least one bone cutting edge arranged for cutting the bone transverse to the forward pointing direction and arranged in a general axial direction.

33. A head according to claim 32, comprising at least a second substantially axially
5 arranged bone cutting edge for adapted for cutting at an opposite rotation direction of said head than a rotation direction for which said head drills said tunnel.

34. A head according to claim 32, wherein said head is mounted off-center on an elongate
10 rod.

35. A head according to claim 32, wherein said head is cannulated.

36. A method of fixating soft material to bone, comprising:
(a) forming a tunnel in said bone;
15 (b) forming an expansion region in at least a part of said tunnel;
(c) inserting soft material into said expansion region via said tunnel; and
(d) fixating said soft tissue in said tunnel.

37. A method according claim 36, wherein said soft material comprises a ligament or a
20 tendon or a ligament or a tendon replacement graft.

38. A method according to claim 37, wherein said fixating is mechanical attachment.

39. A method according to claim 38, wherein said mechanical attachment is a mechanical
25 interference attachment.

40. A method according to claim 38, wherein said mechanical attachment is a one way
attachment prevent motion in only one direction along said tunnel.

30 41. A method according to claim 38, wherein said mechanical attachment uses an
expanding element to lodge in said expansion.

42. A method according to claim 38, wherein said mechanical attachment uses a non-expanding element to lodge in said expansion.
43. A method according to claim 38, wherein said mechanical attachment is adapted to hold
5 on its own for less than 2 months.
44. A method according to claim 38, wherein said mechanical attachment bio-degrades.
45. A method according to claim 38, wherein said mechanical attachment uses a
10 biodegradable element.
46. A method according to claim 38, wherein said mechanical attachment does not use a setting element.
- 15 47. A method according to claim 38, wherein said fixating does not include adhesive fixating.
48. A method according to claim 36, wherein said fixating comprises adhesive fixating.
- 20 49. A method according to claim 48, wherein said fixating comprises providing a settable material in said expansion.
50. A method according to claim 36, wherein forming an expansion comprises crushing bone adjacent said tunnel.
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51. A method according to claim 36, wherein forming an expansion comprises removing bone adjacent said tunnel.
52. A method according to claim 36, wherein forming a tunnel and forming an expansion
30 comprise using a same tool for drilling and expansion.
53. A method according to claim 52, comprising changing a mode of said tool by changing a rotation direction thereof.

54. A method according to claim 36, wherein said expansion region is tapered towards said tunnel.

5 55. A method according to claim 36, wherein said tunnel extends in two directions away from said expansion region.

56. A method according to claim 36, wherein inserting soft material comprises pushing said soft material into said expansion region.

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57. A method according to claim 36, wherein inserting soft material comprises pulling said soft material into said expansion region.

15 58. A method according to claim 36, comprising pre-treating said material to assist fixating thereof.

59. A method according to claim 58, wherein pre-treating comprises thickening using a suture.

20 60. A method according to claim 58, wherein pre-treating comprises thickening using a setting material.

61. A method according to claim 36, comprising attaching an end of said soft material to a second bone.

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62. A method according to claim 37, wherein said ligament is an anterior cruciate ligament.

63. A method according to claim 37, wherein said ligament is a posterior cruciate ligament.

30 64. A method according to claim 37, wherein said ligament is a shoulder ligament.

65. A method of pre-treating graft material to facilitate fixating to bone, comprising:
(a) providing a graft material suitable to be used for a ligament or tendon; and

(b) increasing a cross-section of said graft at at least one end thereof.

66. A method according to claim 65, wherein increasing a cross-section comprises attaching an anchoring aid to said graft.

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67. A method according to claim 66, wherein said anchoring aid comprises a layer of a settable material said graft.

68. A method according to claim 65, wherein increasing a cross-section comprises folding
10 said graft.

69. A method according to claim 65, wherein increasing a cross-section comprises tying said end with a suture.

15 70. A method according to claim 65, wherein increasing a cross-section comprises dipping said material in a settable material.

71. A method according to claim 65, comprising adding a suture loop for pulling to said graft.

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72. An enhanced graft formed by the method of claim 65.